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Evaluating the Effects of Microalgal Extracts on the Germination and Phenolic Contents of Ayocote Bean (*Phaseolus coccineus*) Seeds

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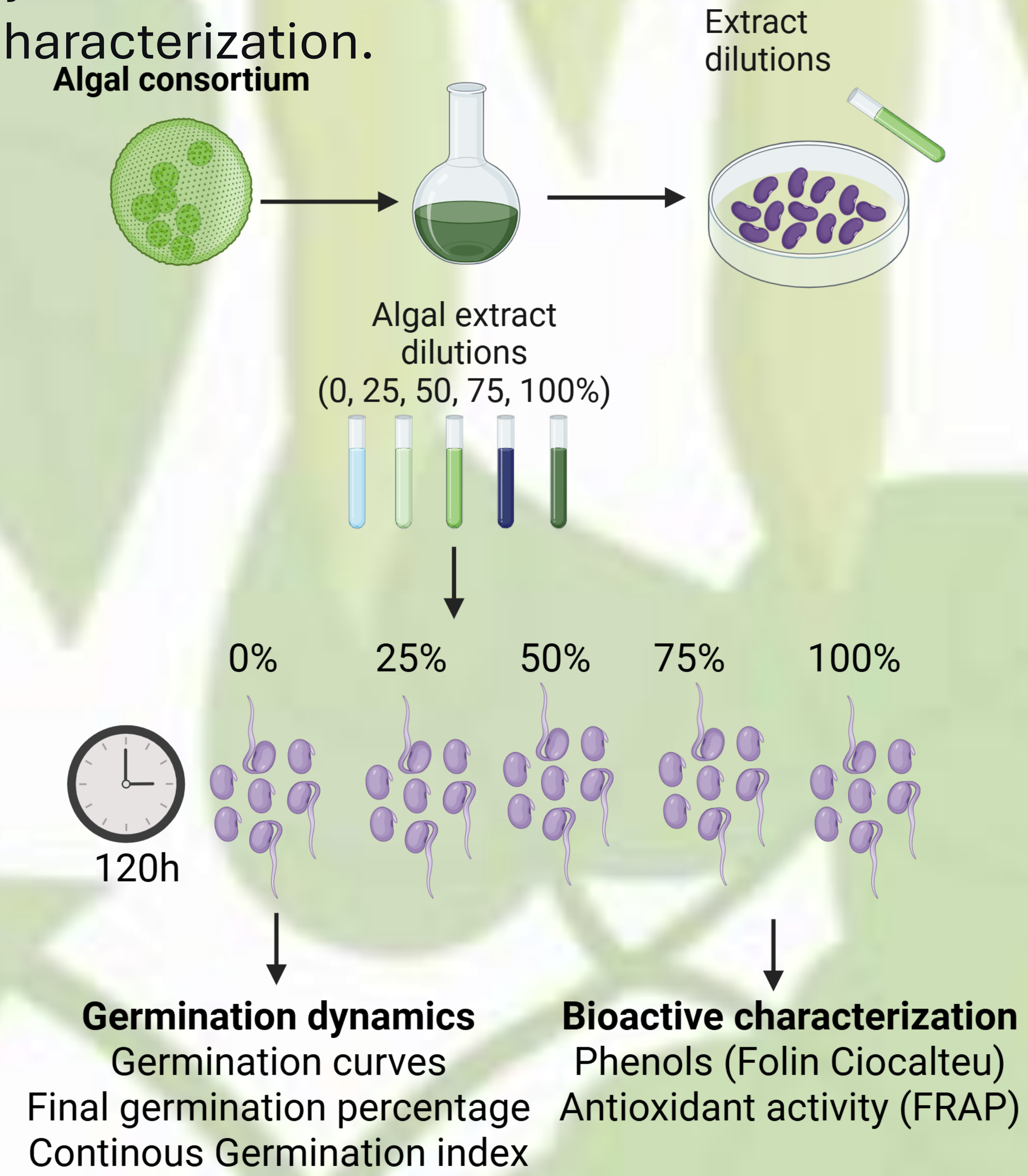
INTRODUCTION & AIM

Biostimulants derived from microalgae have demonstrated the capacity to induce seed priming, a pre-sowing treatment known to improve germination rates and uniformity, thereby contributing to more robust seedling establishment and overall agronomic yield (López et al., 2023; Ribeiro et al., 2024). Ayocote beans are a traditional food in Mexico, despite its importance, its cultivation faces numerous challenges, including susceptibility to environmental stressors and a need for improved germination efficiency (Ribeiro et al., 2024; Yadav et al., 2024).

This investigation therefore seeks to elucidate the impact of various microalgal extracts on the germination dynamics and the subsequent accumulation of phenolic compounds within Ayocote bean seeds, aiming to identify optimal extract formulations for agricultural enhancement.

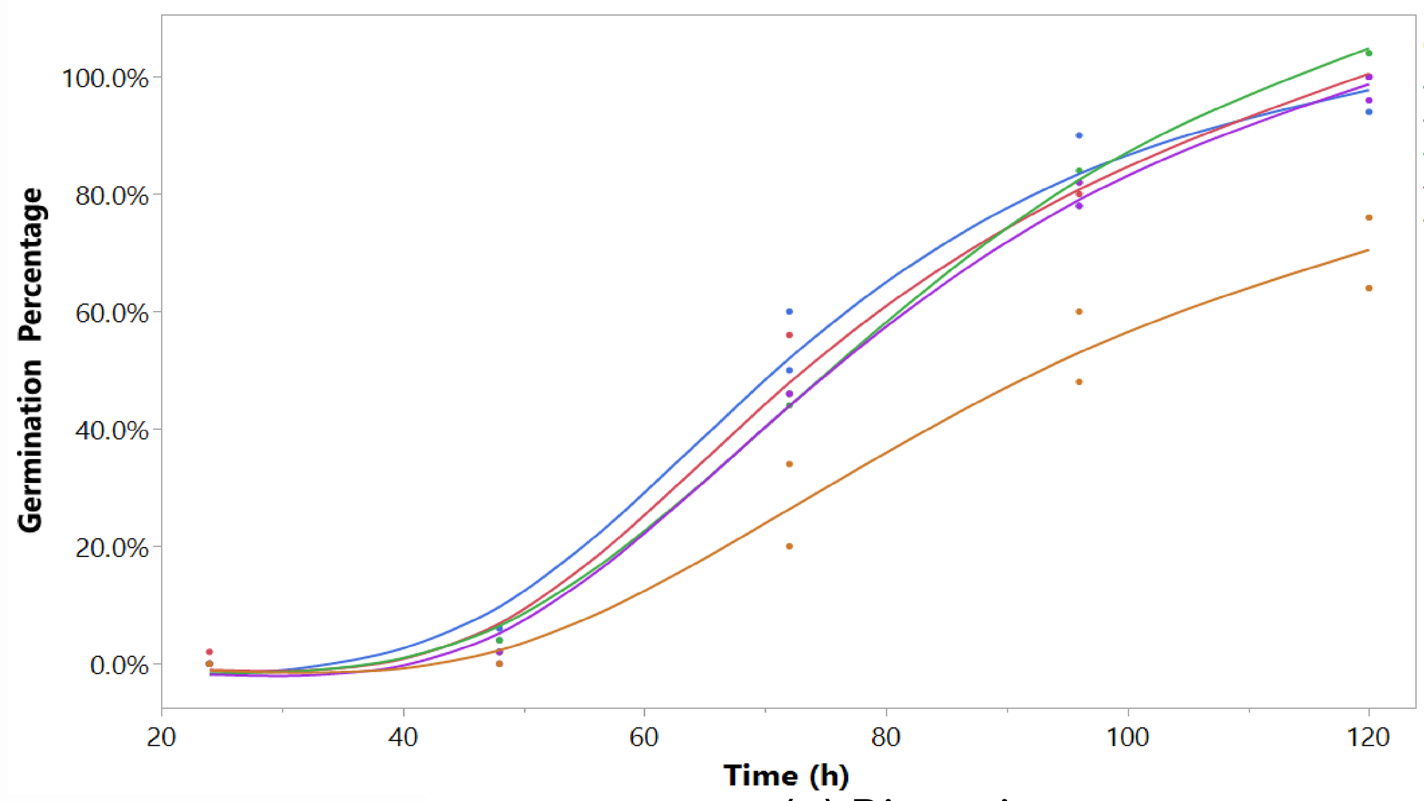
METHOD

Aqueous algal extracts were prepared (1:10 w/v) and diluted. Seed germination bioassays were conducted in Petri dishes (15 seeds/dish, triplicates) under controlled conditions (22 ± 2°C, darkness). Germination was monitored for 120h. ANOVA was perfomed on germination dybamic measures and bioactive characterization.



RESULTS & DISCUSSION

(a) Germination curves



(b) Germination parameters

% Algal extract	% Germinated seeds	CGI	SGI
0	97	104.76	0
25	100	108.0	0.03
50	100	112.32	0.07
75	98	105.84	0.01
100	70	75.60	-0.28

(c) Bioactive measures

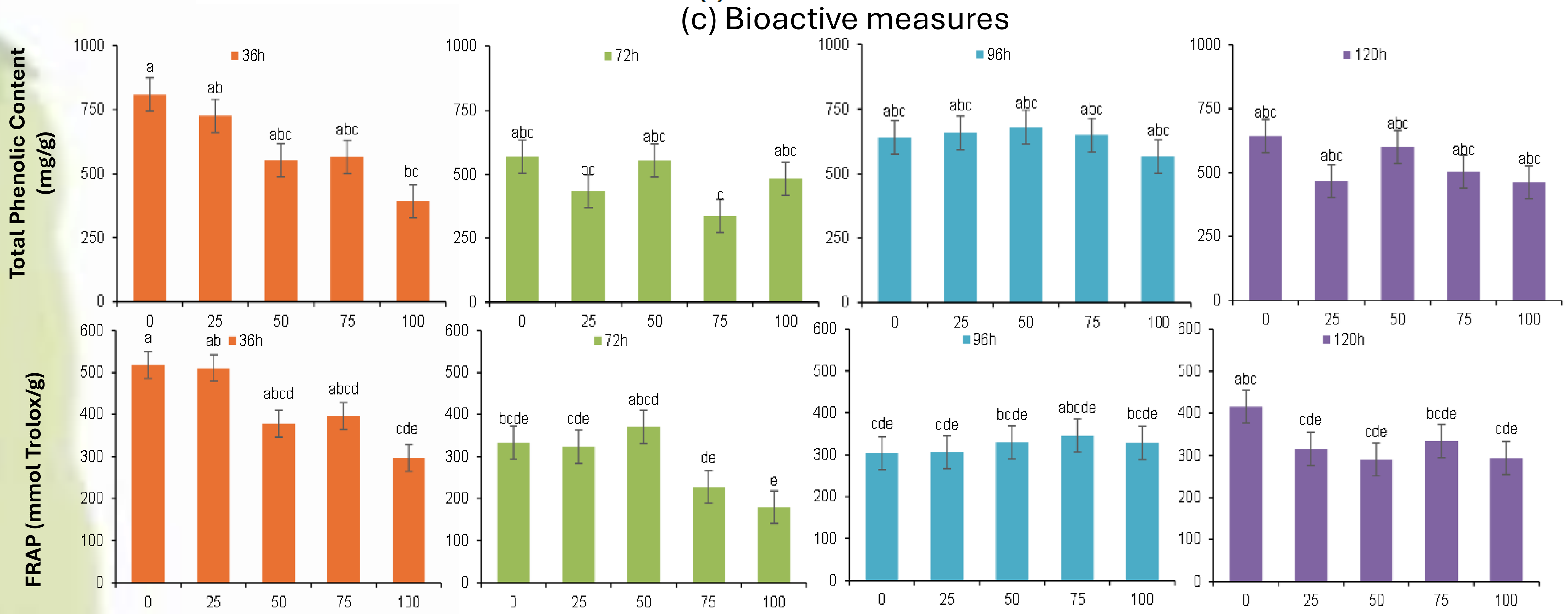


Figure 2. Germination results for a 120h trial using diluted algal extracts on ayocote bean seeds.

Extract concentration did not significantly affect the final germination percentage (ANOVA, P=0.086), it had a pronounced effect on germination speed and seedling physiology, as can be seen on the differences between the germination curves (Fig 2a). After observing this, CGI were derived from the functional data analysis of the smoothed germination curves, as the area under the curve (Fig 2b). This confirmed the observation, as a decrease in the CGI of 75 and 100% extract concentrations (P=0.003) was detected. CGI was able to differentiate between curves with high final germination percentages (Talská et al, 2020). The highest concentration (100%) even exhibited moderate toxicity (SGI: -0.27). In contrast, CGI of low to moderate concentrations (25–50%) enhanced the germination process, suggesting a biostimulating effect, with peak performance observed at 50% (Fig 2b CGI: 112.32 area units and SGI:+0.07), related with improved vigor (Mohammed et al., 2023). Bioactive compound levels were also significantly influenced, with total phenolics (P=0.003) and FRAP (P≤0.001) varying throughout germination time (Fig 2c). In general, Phenolics decreased at 72h, regardless of the concentration, and later increased or maintained with time (Fig 2c). Similarly, a notable recovery in antioxidant power values between 72 and 96 hours, particularly at lower concentrations. This suggested a stress-adaptive response potentially linked to the increased phenolic content observed after 72 hours (García-Pérez et al., 2020; Jagathy & Lavanya, 2021).

CONCLUSION

Algal extracts exhibit concentration-dependent effects: biostimulatory at low doses (25–50%) and phytotoxic at high doses (≥75%). Optimal use requires dose calibration to harness benefits while avoiding inhibition. These findings support algal extracts as sustainable agro-inputs, pending further field validation.

REFERENCES

García-Pérez, P., Lozano-Milo, E., Landín, M., & Gallego, P. P. F. (2020). https://doi.org/10.3390/antiox9030210
Jagathy, K., & Lavanya, K. (2021). https://doi.org/10.17485/ijst/v14i30.855
López, E. N., Gallardo-Rodríguez, J. J., Cerón-García, M. C., Gallego-López, I., Acién, G., & Grima, E. M. (2023). https://doi.org/10.1007/s10811-023-02919-y
Mohammed, S., El-Sheekh, M. M., Aly, S. H., Alharbi, M., Elkelish, A., & Nagah, A. (2023). https://doi.org/10.3389/fpls.2023.1136325
Talská et al. (2020). https://doi.org/10.1002/aps3.11366
Ribeiro, C. F., Costa, G. de O., Cardoso, F. K., Santos, A. A. dos, Freitas, M. B. de, Sandjo, L. P., & Stadnik, M. J. (2024). https://doi.org/10.21203/rs.3.rs-4277123/v1
Yadav, A., Singh, S., & Yadav, V. (2024). https://doi.org/10.1038/s41598-023-50513-6